**David H. Hurley**

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**Education:**

Ph.D., Materials Science and Engineering, Johns Hopkins University, September 1997. *Investigation of Laser Generated Ultrasound in Single Crystal Materials and Carbon Epoxy Composites*

M.S., Mechanical Engineering, Montana State University, June 1991. *Determination of Elastic and Optical Properties of Thin Plates and Investigation of the Mechanisms Involved in the Laser Generation of Ultrasound*

B.S., Physics, University of North Carolina, Chapel Hill, May 1988.

**Employment:**

January 1999 - Present: **Advisory Scientist**, Idaho National Laboratory, Idaho Falls, ID.
Specific contributions include:

- Developed a novel method for simultaneously imaging anisotropic acoustic and thermal phonon properties of thin film materials with micron (lateral) and nanometer (depth) resolution. This approach is being exploited to investigate fundamental thermal and elastic properties of actinide bearing inert matrix fuels.
- Demonstrated coherent shear phonon generation and detection with ultrafast optical pulses. Direct piezoelectric and thermoelastic generation was achieved by breaking the sample lateral symmetry using crystalline anisotropy.
- Investigated, for the first time, the interaction of GHz surface acoustic waves with individual grain boundaries. This collaborative effort, with researchers from Hokkaido University, involved developing a first principle understanding of acoustic wave reflection and refraction in the presence of material microstructure.
- Employed ultrafast optical techniques to generate and detect surface acoustic waves in excess of 20 GHz in crystalline semiconductors. This approach is being exploited to steer electrons in piezoelectric semiconductors.
- Probed material microstructure using nonlinear acoustics. Investigated reducing sensitivity to background nonlinearity by mixing surface acoustic waves.

July 1998 – December 1999: **Postdoctoral Fellow**, Hokkaido University, Sapporo, Japan.
Specific contributions include:

- Developed phase sensitive common path interferometer appropriate for detection of picosecond phonon pulses. This interferometer is being employed by several international research groups to study the generation and propagation of picosecond acoustic pulses in semiconductor and metallic thin films.
- Investigated non-thermal optical generation of phonon pulses in crystalline material.
- Employed ultrafast optical techniques to generate and detect shear acoustic phonon pulses.

November 1997 – June 1998: **Postdoctoral Fellow**, Johns Hopkins University, Baltimore, Maryland. Specific contributions include:

- Designed an experimental technique to monitor degree of polymer cure using high-Q piezoelectric transducers.
- Developed a model for laser generation of ultrasound in anisotropic materials. This model elucidates the artifacts of anisotropy when using laser ultrasonics to characterize carbon epoxy composites.
- Developed cineholographic and deflection probe system to monitor the evolution of the plasma plume and shock front resulting from laser ablation.
- Developed a technique to measure the optical absorption coefficient using laser generated plate waves.

**Honors and Awards:**

- Member, Sigma Xi.
- Japanese Society for the Promotion of Science postdoctoral fellowship recipient (1998).
- National Research Council postdoctoral fellowship recipient (1998). Award declined in lieu of acceptance of JSPS fellowship.

**Professional Activities:**

- Session Chair, Gordon conference on Photothermal and Photoacoustic Phenomena, Trieste Italy, (July 2005).
- Panel presenter, Department of Energy sponsored workshop, *Assuring Materials Performance in Extended Service*, Salt Lake City, Utah (2004).
- Session Chair, Gordon conference on Photothermal and Photoacoustic Phenomena, New London NH, (July 2003).
- Member, Materials Research Society.
- Member, Acoustical Society of America.
- Member, American Society of Mechanical Engineers.

**Recent Grants and Contracts:**

Title: Measuring Thermal Properties of Materials in High Radiation Environments
Agency: Department of Energy, Advanced Fuel Cycle Initiative
Amount and Duration: $260,000 (2005-2006)

Title: Elastic Wave Interaction with Grain Boundaries on a Microscopic Scale
Agency: Department of Energy, Office of Basic Energy Science
Amount and Duration: $640,000 (2003-2005)

Title: Materials Research for Energy Security
Agency: Department of Energy, Office of Biological and Environmental Research
Amount and Duration: $135,000 (2004)

Title: *In Situ* Laser-Based Characterization of Fatigue Damage in High Temperature Environments
Agency: Laboratory Directed Research and Development Program
Amount and Duration: $600,000 (2005-2007)

**Current Supervision Duties:**

- Mathew Fig, INL summer student, Completed requirements for Masters Degree.
- Chiaki Miyasak, 2004 and 2005 INL Postdoctoral Fellow.

**Research Interests:**

Ultrafast optical techniques to characterize the mechanical, thermal and electronic properties of thin films and nanostructures. Theoretical and experimental study of linear and nonlinear crystal acoustics. Fundamental interaction of acoustic waves with individual microstructural features. *In situ* laser ultrasonic and laser-based thermal wave imaging of material properties in high temperature environments (e.g. fatigue damage, corrosive film growth, development of elastic anisotropy in creep environments).

**Publications:**

21. D. H. Hurley, O. B. Wright, O. Matsuda, T. Suzuki, S. Tamura, Y. Sugawara, Time-Resolved Surface Acoustic Wave Propagation Across a Single Grain Boundary, *Physical Review B*, **71** (2005).

20. S. Reese, D. H. Hurley, H. Rollins, Effect of Surface Acoustic Waves On The Catalytic Decomposition of Ethanol Employing a Comb Transducer for Ultrasonic Generation, , *Ultrasonics Sonochemistry*, **13**, 283 (2006).

19. D. H. Hurley, K. L. Telschow, Simultaneous Microscopy of Elastic and Thermal Anisotropy, *Physical Review B, Rapid Communications*, **71**, 241410 (2005).

18. D. H. Hurley, J. B. Spicer, Line-Source Representation for Laser-Generated Ultrasound in an Elastic Transversely Isotropic Half-Space, *Journal of the Acoustical Society of America*, **116,** 2914 (2004).

17. D. H. Hurley, Laser-Generated Thermoelastic Acoustic Sources in Anisotropic Materials, *Journal of the Acoustical Society of America*, **115**, 2054, (2004).

16. O. Matsuda, O. B. Wright, D. H. Hurley, V. E. Gusev, K. Shimizu, Coherent Shear Phonon Generation and Detection with Ultrashort Optical Pulses, *Physical Review Letters*, **93**, 95501 (2004).

15. D. H. Hurley, K. L. Telschow, V. Deason, Y. Sugawara, O. B. Wright, Microscopic Laser Ultrasonics for Determining Microstructure Changes due to Material Degradation, *Material Science and Technology*, **3**, 223 (2004).

14. D. H. Hurley, K. L. Telschow, Picosecond Surface Acoustic Waves Using a Suboptical Wavelength Absorption Grating, *Physical Review B., Brief Reports*, **66**, 153301 (2002).

13. D. H. Hurley, K. L. Telschow, Probing Acoustic Nonlinearity on Length-Scales Comparable to Material Grain Dimensions, *Ultrasonics*, **40**, 617, (2002).

12. D. H. Hurley, K. L. Telschow, Probing Acoustic Nonlinearity by Mixing Surface Acoustic Waves, *Review of Progress in Quantitative Nondestructive Evaluation*, **20**, 1236 (2001).

11. D. H. Hurley, O. B. Wright, O. Matsuda, V. E. Gusev and O. V. Kolosov, Laser Picosecond Acoustics in Isotropic and Anisotropic Materials, *Ultrasonics*, **38**, 470 (2000).

10. P. J. Shull, D. H. Hurley, J. B. Spicer, J. W. M. Spicer, Spatial and Temporal Control of the Degree of Cure in Composite Structures, *Polymer Eng. Sci.*, **40**, 1157 (2000).

9. D. H. Hurley, O. B. Wright, Detection of Ultrafast Phenomena Using a Modified Sagnac Interferometer, *Journal of Optics Letters*, **24**, 1305 (1999).

8. D. H. Hurley, J. B. Spicer, Point-Source Representation for Laser-Generated Ultrasound in an Elastic Transversely Isotropic Half Space, *Journal of Applied Physics*, **86**, 3423 (1999).

7. D. H. Hurley, J. B. Spicer, An Investigation of the Effects of Material Anisotropy and Heterogeneity on Pulsed, Laser-Generated Acoustic Signals, *Ultrasonics Ferroelectrics and Frequency Control*, **46**, 1387 (1999).

6. D. H. Hurley, J. B. Spicer, Laser Generated Ultrasound in Single-Crystal Mindlin-Type Plates: Theory and Experiment, *Ultrasonics*, **36**, 987 (1998).

5. D. H. Hurley, J. B. Spicer, T. W. Murray, J. W. Wagner, Investigation of the Anisotropic Nature of Laser Generated Ultrasound in Zinc and Unidirectional Carbon Fiber Epoxy Composites, *Ultrasonics*, **36**, 355 (1998).

4. D. H. Hurley, J. B. Spicer, R. J. Conant, K. L. Telschow, Determination of the Optical Absorption Coefficient via Analysis of Laser Generated Plate Waves, *Ultrasonics Ferroelectrics and Frequency Control*, **44**, 902 (1997).

3. D. H. Hurley, J. B. Spicer, J. W. Wagner, T. W. Murray, Investigation of the Anisotropic Nature of Laser Generated Ultrasound in HCP Crystals and Unidirectional Carbon Epoxy Composites, *Review of Progress in Quantitative Nondestructive Evaluation*, **16**, 475 (1997).

2. J. B. Spicer, D. H. Hurley, Epicentral and Near Epicenteral Displacement on Pulsed Laser Irradiated Metallic Surfaces, *Applied Physics Letters*, **68**, 3561 (1996).

1. J. Diaci, D. Hurley, J. W. Wagner, J. Mozina, Simultaneous Monitoring of Ablative Shocks in Air by High-Speed Cineholography and Multiple-Pass Deflection Probe, *Applied Surface Science*, **96-98**, 154-155 (1996).

**Presentations (invited):**

16. D.H. Hurley, Laser Ultrasonics: Picoseconds to Milliseconds, *Department of Mechanical Engineering Lecture Series*, Boston University, Boston (2005).

15. D. H. Hurley, Laser-Based Materials Characterization on Nano/Micro/Millimeter Length Scales, *Department of Mechanical Engineering Lecture Series*, University of Ljubljana, Slovenia (2005).

14. D. H. Hurley, K. L. Telschow, Y. Sugawara, O.B. Wright, T. Lillo, *In Situ* Laser Ultrasonics for Determining Material Properties, *INL Assuring Materials Performance in Extended Service Workshop*, Salt Lake City, Utah (2004).

13. D. H. Hurley, O. B. Wright, O. Matsuda, V. E. Gusev and O. V. Kolosov, Laser Picosecond Acoustics in Isotropic and Anisotropic Materials, *Ultrasonics International*, Copenhagen Denmark (1999).

12. J. W. Wagner, J. B. Spicer, T. W. Murray, D. H. Hurley, M. Ehrlich, Fundamental Issues for Optimization of Laser Sources for Generation of Ultrasound, *Third Joint Acoustical Society of America and Acoustical Society of Japan Meeting*, Honolulu, Hawaii (1996).

**Presentations (contributed):**

11. O. Matsuda, O. B. Wright, D. H. Hurley, V. E. Gusev, K. Shimizu, Generation and Detection of Picosecond Shear Acoustic Pulses with Ultrashort Laser Pulses in Anisotropic Materials, *World Congress on Ultrasonics/Ultrasonics International*, Beijing, China (2005).

10. D. H. Hurley, Simultaneous Microscopy of Elastic and Thermal Anisotropy, *Seeing at the Nanoscale III*, Santa Barbara, California (2005).

9. D. H. Hurley, K. L. Telschow, V. Deason., Y. Sugawara, O. B. Wright, Microscopic Laser Ultrasonics for Determining Microstructure Changes due to Material Degradation, *The Minerals, Metals & Materials Society Symposium on Materials Prognosis*, New Orleans, Louisiana (2004).

8. O. Matsuda, T. Tachizaki, D. H. Hurley and O. B. Wright, Laser Picosecond Acoustics with Oblique Probe Light Incidence, *Proc. Autumn Conference of the Physical Society of Japan*, Kasugai, Japan, vol. 57, No. 2, pt. 4, p.638 (2002).

7. K. L. Telschow, D. H. Hurley, Laser Acoustic Microstructure Analysis at the Micron and Nanometer Scale, *Proceedings of the Twentieth Symposium on Energy Engineering Sciences*, Argonne National Laboratory, Argonne, Illinois (2002).

6. D. H. Hurley, K. L. Telschow, Probing Acoustic Nonlinearity on Length-Scales Comparable to Material Grain Dimensions, *Ultrasonics International*, Delft, Holland (2001).

5. D. H. Hurley, K. L. Telschow, Probing Acoustic Nonlinearity by Mixing Surface Acoustic Waves, *Review in Quantitative NDE*, Ames, IA (2000).

4. D. H. Hurley, J. B. Spicer, Investigation of the Anisotropic Nature of Laser-Generated Ultrasound in Zinc and Unidirectional Carbon Epoxy Composites, *Ultrasonics International*, Delft, Holland (1997).

3. D. H. Hurley, J. B. Spicer, Laser Generated Ultrasound in Single Crystal Zinc and in Unidirectional Carbon Epoxy Composites, *8th International Symposium on Nondestructive Evaluation*, Boulder, Colorado (1997).

2. D. H. Hurley, J. B. Spicer, J. W. Wagner, T. W. Murray, Investigation of the Anisotropic Nature of Laser Generated Ultrasound in HCP Crystals and Unidirectional Carbon Epoxy Composites, *Review of Progress in Quantitative NDE*, Brunswick, ME (1996).

1. P. J. Shull, J. L. Champion, D. H. Hurley, J. W. Spicer, J. B. Spicer, Process Control to Reduce Over-Temperature of Resin Cure in Scrimp Manufactured Composites, *1996 Review of Progress in Quantitative NDE*, Brunswick, ME (1996).

**List of References:**

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